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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/766,485	01/29/2004	Jong-Won Lee	SEC.1117	3741

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EXAMINER	
NGUYEN, GEORGE BINH MINH	
ART UNIT	**PAPER NUMBER**
3723	

DATE MAILED: 12/30/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/766,485	LEE, JONG-WON	
	Examiner	Art Unit	
	George Nguyen	3723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4 and 6-10* is/are rejected.

7)☒ Claim(s) *5 and 11* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *29 January 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Receipt is acknowledged of the Foreign Priority Document filed on January 29, 2004.

Claims 1-11 are presented for examination.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4 and 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Perlov et al.'6,036,583 in view of Grumazescu'5,809,157.

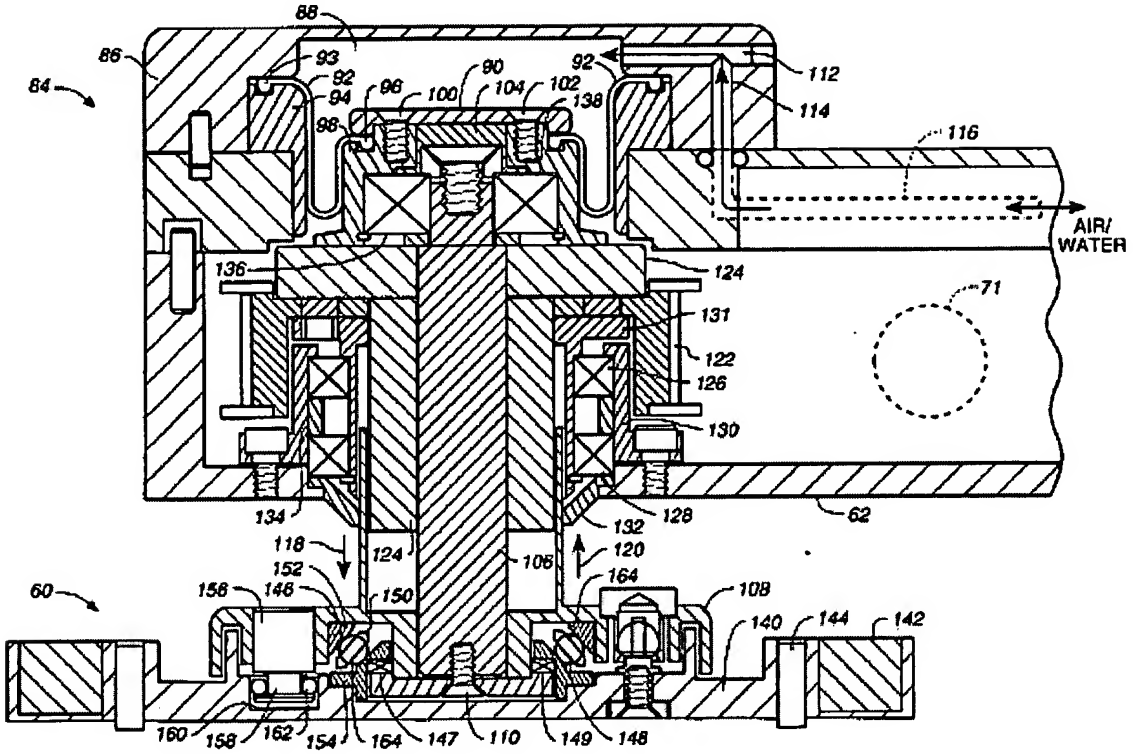
With reference to Figure 4C, col. 3-4, Perlov discloses the claimed invention including the following:

(1) a disk holder (140) supporting a polishing disk.

(2) a conditioner head (60) having a rotary drive (122/124).

(3) a linear driving device (84) coupled conditioner head (60) to arm (62) to drive conditioner head (60) between an extended position and a retracted position.

However, Perlov does not disclose a linear driving device including a first magnet and a second magnet as set forth in the claim.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38 for moving cassettes 28 from a holding station 39 into tub 24 and a substrate blade 40 for transferring substrates from tub 24 to transfer station 16.

Carousel 18 has a support plate 42 with slots 44 through which shafts 46 of carrier heads 20 extend. Carrier heads 20 can independently rotate and oscillate back-and-forth in slots 44 to achieve a uniformly polished substrate surface. Carrier heads 20 are rotated by respective motors 48, which are normally hidden behind removable sidewalls 50 of carousel 18. In operation, a substrate is loaded from tub 24 to transfer station 16, from which the substrate is transferred to a carrier head 20; carousel 18 then transfers the substrate through a series of one or more polishing stations 14 and finally returns the polished substrate to transfer station 16.

Each polishing station 14 includes a rotatable platen 52, which supports a polishing pad 54, and a pad conditioner 56; platen 52 and conditioner 56 are both mounted to a tabletop 57 inside polishing apparatus 10. Each pad conditioner 56 includes a conditioner head 60, an arm 62, and a base 64 for positioning conditioner head 60 over the surface of a polishing pad 54 to be conditioned. Each polishing station 14 also includes a cup 66, which contains a fluid for rinsing conditioner head 60.

Referring to FIGS. 2A and 2B, in one mode of operation, polishing pad 54 is conditioned by pad conditioner 56 while polishing pad 54 polishes a substrate which is mounted on carrier head 20. Conditioner head 60 sweeps across polishing pad 54 with a motion that is synchronized with the motion of carrier head 20 across polishing pad 54. For example, a carrier head 20 with a substrate to be polished may be positioned in the center of polishing pad 54 and conditioner head 60 may be immersed in a rinsing fluid contained within cup 66. During polishing, cup 66 may pivot out of the way as shown by arrow 69, and conditioner head 60 carrying a substrate may be swept back-and-forth across polishing pad 54 as shown by arrows 70 and 72, respectively. Three water jets 71, 73, and 75 may direct streams of water toward polishing pad 54 to rinse slurry from the pad surface.

For further details regarding the general features and operation of polishing apparatus 10, please refer to co-pending application Ser. No. 08/549,336, filed, Oct. 27, 1995, by Perlov et al., entitled "Continuous Processing System for Chemical Mechanical Polishing," and assigned to the assignee of the present invention, which is herein incorporated by reference.

Referring to FIG. 3A, it has been realized that when a driving force (F_{driver}) is applied to a conditioner head 75 from a position that does not lie along a line that is normal to a polishing pad surface 76, the driving force and the responsive normal force (F_{normal}) result in a counterclockwise torque (T') that tends to raise conditioner head 75 off polishing pad surface 76. Such torque generation may lead to instability and thereby reduce the ability to controllably apply force against polishing pad surface 76. As shown in FIG. 3B, when, in accordance with one aspect of the invention, actuating force is applied to conditioner head 60 from a position that lies along a line 82 which is substantially normal to polishing pad surface 76, the normal force and the driving force both lie along the same line 82 and little or no torque is generated. The invention therefore allows force to be controllably and stably applied against polishing pad surface 76, improving the uniformity with which a polishing pad surface can be conditioned and thereby improving the overall polishing process.

Referring to FIGS. 4A and 4B, support arm 62 of pad conditioner 56 has one end coupled to conditioner head 60 and another end coupled to base 64, which sweeps conditioner head 60 across a polishing pad surface. A driver 84 couples conditioner head 60 to arm 62 and drives conditioner head 60 between an extended position (FIG. 4A) and a retracted position (FIG. 4B). As explained above, driver 84 applies an actuating force to conditioner head 60 from a position that lies along a line that is substantially normal to the polishing pad surface to be conditioned, so as to significantly reduce the amount of torque generated in polishing pad conditioner 56.

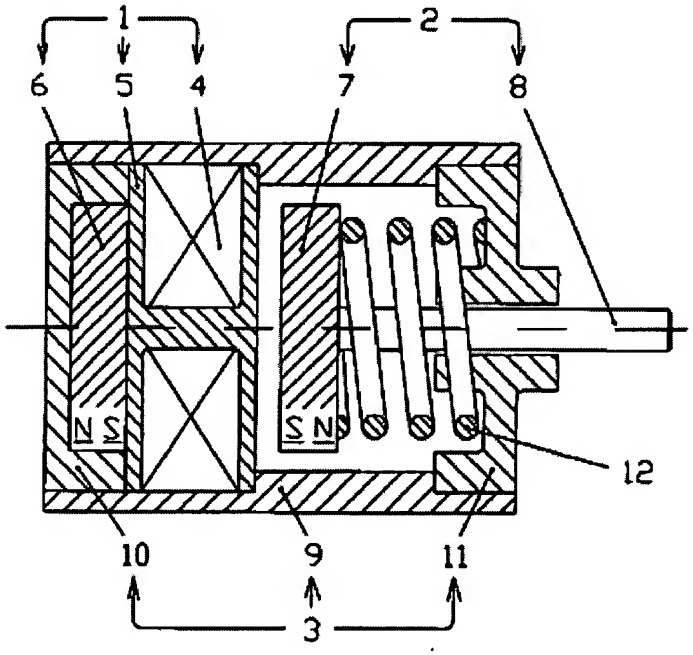
Referring to FIG. 4C, driver 84 includes a housing 86 that defines an interior portion of a fluid cavity 88. Fluid cavity 88 is further defined by a face plate 90 and a fluid membrane 92, which is made of neoprene rubber with, for example, a hardness of about 40 durometer and a thickness of about 0.03 inch. Fluid membrane 92 has one end 93 that is attached to housing 86 by an annular clamp 94 and another end 96 that is attached to face plate 90 by an annular clamp 98 which is coupled to face plate 90 by bolts 100, 102. A flange 104 couples face plate 90 to a spline shaft 106 which is, in turn, coupled to a flange 108 of conditioner head 60 by a bolt 110. In operation, fluid cavity 88 receives pressurized air through fluid channels 112 and 114 defined in driver housing 86 and through a fluid channel 116 which extends through arm 62 and through base 64 to an inlet port 117 (FIG. 4A). The build-up of air pressure inside fluid cavity 88 drives face plate 90, spline shaft 106, and conditioner head 60 in the direction indicated by arrow 118. As air is evacuated from fluid cavity 88, the reduction in air pressure in fluid cavity 88 causes face plate 90, spline shaft 106, and conditioner head 60 to retract in the direction indicated by arrow 120.

Fluid channel 116 includes separate tubes for respectively receiving air and a rinsing solution, such as water. The rinsing solution tube is coupled to water jets 71, 73, and 75 located along arm 62 (see FIGS. 2A, 2B, and 4A). The rinsing solution may be used to rinse a polishing pad surface before, during, or after polishing to prevent the build-up of slurry deposits.

Driver 84 also includes a toothed sheave 122 which is coupled to a spline nut 124. Toothed sheave 122 and spline nut 124 are rotated by a toothed drive belt (not shown) which is driven by a motor in base 64 (discussed in detail below). Spline nut 124 engages spline shaft 106 and thereby causes spline shaft 106 and conditioner head 60 to rotate when driven by the drive belt. A pair of annular bearings 126, 128 are held in place between arm 62 and spline nut 124 by an upper collars 130, 131 and a lower collar 132; annular bearings 126, 128 are spaced apart by an annular spacer 134. Annular bearings 126, 128 allow spline nut 124 to rotate freely with respect to arm 62. A pair of bearings 136, 138 allow spline nut 124 and spline shaft 106 to rotate freely with respect to face plate 90.

Conditioner head 60 includes a face plate 140 which has an annular magnet 142 for holding in place an end effector (not shown) which is used to condition a surface of a polishing pad; pins 144 are used to engage and thereby transfer torque to an end effector held to face plate 140. Face plate 140 and flange 108 are coupled together by a gimbal mechanism which includes a plurality of ball bearings 146, 148 seated within holes in an annular cage 150 and positioned between an upper annular race 152 and a lower annular race 154. Ball bearings 146, 148 and springs 147, 149 allow face plate 140 to nutate with respect to spline shaft 106. The degree of nutation is limited by three torque transfer pins 156 which are mounted to flange 108 (only one torque transfer pin is shown in FIG. 4B). Torque transfer pins 156 have protrusions 158 which extend into recesses

With reference to Figure 1, col. 1-2, Grumazescu'157 discloses an electromagnetic linear drive having a stationary magnet unit 1 and a mobile magnet unit 2. The mobile unit includes a mobile magnet fastened to a shaft made of diamagnetic material which holds, positions, and further transfer the linear motion of the mobile magnet to the driven device. The advantage of the electromagnetic linear drive is to provide precise movement in application such as robotics.



ELECTROMAGNETIC LINEAR DRIVE

FIELD AND BACKGROUND OF THE INVENTION

This invention relates to an electromagnetic linear drive used to drive piston or diaphragm pumps as well as a loudspeaker. This device can be also used where precise linear motion or positioning is required like robotics, instruments, flow control, etc.

An important part of research and development work particularly for piston pumps construction, is concerned with the creation of a simple, lightweight, compact and efficient linear drive to drive the piston, having low power consumption and good output force. In some piston pumps the linear motion of the piston is obtained by transforming the circular motion of an electric motor using a crank and connecting rod assembly. The main disadvantage of this method is that the overall efficiency of the pump is adversely affected by the efficiency of the crank and connecting rod assembly. Another solution is the use of an electromagnet with a mobile element made of ferromagnetic material driving the piston or the diaphragm of a pump oscillating at the frequency of 50–60 Hz of the AC power source. This solution has the disadvantage of low power output and limited travel of the mobile element, resulting in low flow and low pressure capability.

In U.S. Pat. No. 5,268,662, there is disclosed a plunger type electromagnet used to control valves. It is a classical method to use a plunger type electromagnet to obtain direct linear motion. This method has negative characteristics affecting its overall efficiency like: its operating frequency is limited by its ferromagnetic core, has magnetic losses generated by Foucault currents and heat, has an uncontrolled and small linear travel, it needs additional suppression circuits to function properly, and has low power output compared with its mass.

SUMMARY OF THE INVENTION

The main goal of this invention is to create a more efficient and simple electromagnetic drive, that will convert the electrical energy to mechanical energy, delivering a controlled linear motion output. Some of the distinct features of the present invention resulting in numerous advantages are described below:

it has no magnetic circuit made of ferromagnetic material, which reduces its total mass and magnetic losses due to Foucault currents and the heat;

its mobile element is energetically active, not made of ferromagnetic materials;

its coils are energized by bi-directional pulses;

its upper frequency of operation is limited only by the mechanical inertia of the mobile element;

its linear travel output is up to 10 times greater than a plunger type electromagnet;

its mobile element is driven with the same force in both directions;

when its coils are not energized, the mobile element is centered by magnetic forces;

the movement of its mobile element can be precisely controlled by a common electronic circuit to any position in both directions;

its low inductance coils are energized using very simple electronic circuits without the need of suppression diodes or resistors. Other objects and advantages of the present invention will appear more clearly from the following description accompanied by drawings wherein like numerals refer to alike or equivalent parts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view showing a simplified embodiment according to the invention, where the mobile element is driven only in one direction;

FIG. 2 is a graph showing the static force as a function of distance acting upon the mobile element of the linear drive shown in FIG. 1, in two situations; when it is using the extra energy offered by the permanent magnet, and when it is not using it;

FIG. 3 is a cross-sectional view of a second embodiment of the electromagnetic linear drive able to drive the mobile element in both directions;

FIG. 4 is a graph showing the static forces as a function of distance acting upon the mobile element of the electromagnetic linear drive shown in FIG. 3, resulting from the addition of the independent forces due to the two static acting elements;

FIG. 5 is an illustrative electronic circuit for operating the electromagnetic linear drive shown in FIG. 3;

FIG. 6 is the oscillogram of the current through the coils of the electromagnetic linear drive showing the principle of the motion control of the mobile element;

FIG. 7 is a cross-sectional view of a third embodiment of the electromagnetic linear drive as applied to a loudspeaker;

FIG. 8 is a cross-sectional view of the electromagnetic linear drive in an other embodiment of a speaker; and

FIG. 9 is a cross-sectional view of an other embodiment of the electromagnetic linear drive as applied to a bi-directional speaker.

DETAILED DESCRIPTION OF THE PREFERED EMBODIMENTS

The electromagnetic linear drive according to the present invention consists of a plurality of units interacting together to produce work using a combination of magnetic forces.

In the first preferred embodiment shown in FIG. 1, the electromagnetic linear drive is comprised of a stationary unit 1, a mobile unit 2, and an enclosing assembly 3.

The stationary unit 1, consists of a coil means 4 hereinafter referred to interchangeably as such or simply "the coil", wound around a bobbin means 5 hereinafter referred to interchangeably as such or simply "the bobbin",and a stationary magnet means 6 hereinafter referred to interchangeably as such or simply "the stationary magnet.". The stationary magnet 6 is concentric and firmly attached to the lateral face of the bobbin 5. The bobbin 5 is made of a non-conductive and diamagnetic material. Of course the coil may be used without a bobbin so that reference to the bobbin also means a coil with no bobbin.

The mobile unit 2, is comprised of a mobile magnet means 7, hereinafter referred to interchangeably as such or simply "the mobile magnet," fastened to a linear motion executing means which may be simply a shaft 8.

The enclosing assembly 3, consists of a main housing 9, an end cover 10 and end cover 11.

The main housing 9, holds together the entire apparatus and has at one end the end cover 10 to support and align the stationary unit 1 and at the other end the end cover 11 to provide support and sliding capability to the shaft 8. The end cover 11, also provides support for a compression spring 12.

Thus, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the pneumatic linear drive (84) of Perlov with an electromagnetic linear drive as taught by Grumazescu in order to provide a precise movement of the conditioner head to improve the efficiency of the polishing unit.

Allowable Subject Matter

3. Claims 5 and 11 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Satoh et al.'434 discloses polishing apparatus including attitude controller for dressing apparatus. Easter et al.'868 discloses a conditioner head with magnetic force. Jeong et al.'615 discloses pad conditioner with magnetic oscillator. Leach discloses polishing apparatus with magnetic elements. Funderburg'373 discloses electromagnetic motor.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to George Nguyen whose telephone number is 703-308-0163. The examiner can normally be reached on Monday-Friday/630AM-300PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Hail can be reached on 703-308-2687. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

GEORGE NGUYEN
PRIMARY EXAMINER

George Nguyen
Primary Examiner
Art Unit 3723

GN – December 23, 2004